CONFERENCE ON ANIMAL FEEDS OF TROPICAL AND SUB-TROPICAL ORIGIN

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WORLD ANIMAL PRODUCTION AND FEED SUPPLIES

by

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The world's livestock producers are having difficulty in satisfying the current growth rate in demand for animal products. Indeed, in terms of market demand, livestock products, especially meat, appear to have some of the most promising growth prospects amongst all tropical agricultural commodities. The potential for growth in animal production is even greater if the nutritional desirability of raising the per capita intake of animal protein, which is currently only 5-10 g a day in the poorest countries, to a figure a little nearer to the 75 g/caput/day average of the populations of the developed countries, is taken into consideration.

Much of this potential lies in the less developed countries (LDC's), which contain 58 percent of the world's agricultural land, 70 percent of its cattle, 63 percent of its sheep and 60 percent of its pigs, but produce only 21 percent of its milk, 34 percent of its beef, 50 percent of its mutton, and 37 percent of its pork. In terms of productivity per head of stock, beef and veal ranges from 93 kg in North America to 4 kg in the Far East (Table 1); for pigs, comparable figures are 98 kg in

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ica and 16 kg in Latin America; for poultry, North America produces 12 times as much meat per head of bird as the Far East; and for milk, 30 times as much as Africa. Slide 1a

Whilst the biological limits of animal productivity in North America and Europe have certainly not been reached, the scope for both genetic and nutritional improvement appears to be much less in these regions than in the LDC's. For example, wastage from disease in Europe is currently only a fraction of that in some semi-arid areas where over 40 percent of the calves born usually die before weaning.

In the developing countries, livestock production has grown traditionally at about 1.5 percent p.a., but at present, with population growth often approaching 3 percent p.a. and G.D.P. growth frequently exceeding 5 percent, the growth in domestic demand for livestock products often exceeds 6 percent p.a.

In 1972 per capita agricultural production in the LDC's was actually lower than it was in the early 1960's (Table 2). Slide 2 For most animal products, human population growth in the period 1961/63 - 1969/71 outstripped the growth of animal production; only in the case of pork and poultry did animal production grow at a faster rate than the human population (Table 3). 3

However, because of the inequitable distribution of protein supplies within the population, these figures suggest that in both relative and absolute terms the average animal protein intake of the lower income groups in the LDC's declined during the 1960's.

This situation appears to have been accentuated because people in the developed countries - and the upper socio-economic groups in the developing countries - have been consuming a disproportionate amount of meat. For example, in the USA per capita beef consumption rose from 25 to 52 kg between 1940 and 1972; the same trend can be seen in Europe and Japan. Indeed the high income-elasticity of demand for beef, at most income levels in most societies, and the inability of the industry to meet this demand, have put prices under increasing pressure and this has had the effect of making beef even less accessible to low income consumers. (4)

Much of the increase in production to meet the growing demand for livestock products in the wealthier countries has come from the increased use of concentrate feeds (Table 4). Thus although cereals are the most important food staple and provide, for example, 2/3rds of the average human calorie intake in the Far East, as well as a large part of the protein supply for man in many countries, about 300 million tons of the world's grain production, in addition to about 60 million tons of milling offals, are currently used as animal feed. (5)

In the developed countries in the period 1969/71, per capita usage of coarse grains (used mainly for animal feed) averaged 387 kg whereas in the developing countries total use of all grains (used almost entirely for human food) averaged only 178 kg/caput. In the U.S. and Canada per capita utilisation of grain is now approaching one ton a year, of which only about 70 kg are consumed directly through bakery type pro- (6)

ducts; the major part of the rest is consumed through the plant-animal food chain.

The same general trend in increased grain use has also been apparent in some LDC's where economic prosperity has both increased the demand for meat and provided the foreign exchange for feed imports. This occurred in Israel and Taiwan (Table 5) some years ago and has taken place more recently in countries such as Trinidad and Malaysia.

In Brazil, which not only has a booming economy but is fortunate enough to be able to produce its own feed supplies, soybean use in the poultry industry increased from 60,000 tons in 1962 to 600,000 tons in 1973, in which year national requirements of balanced concentrates for poultry were 3 million tons or double the 1972 level. However, few LDC's have either the land resources available to maintain such a growth rate in feed production from domestic resources or the foreign exchange to import large quantities of feed.

As a result of this situation an increasing proportion of the world's grain and oilseed production is being utilised for feeding animals to meet the demand for animal products in affluent nations. For example, oilcake consumption for animal feeds rose from 15.4 to 31.2 million tons in the developed countries during the period 1955-68 while at the same time consumption in the LDC's, not all of which was for feed, rose only from 4.5 to 6.2 million tons.

World trade in feed products increased 83 percent between 1960 and 1967 and at current prices was worth around 5 billion dollars a year in

1967. This situation has accentuated an existing trend for basic food commodity prices to increase, and a phenomenal price rise has recently taken place. A number of developing countries have cashed in on this situation, sometimes at the expense of maintaining their own national protein supplies. Indeed the growth of beef exports to the U.S.A. from some Central American countries has led to a decline in domestic per capita protein intakes in the exporting countries.

Thus, the food problem of the Third World is now no longer solely one associated with population and food supplies but is also being strongly influenced by rising affluence, a trend that will surely be accentuated by the enormous new purchasing power of the oil-producing countries, in almost all of which current animal protein intakes are low.

FAO's Indicative World Plan provided some idea of the magnitude of the increase in concentrate feeds that might be required to provide a marginal increase in per capita animal consumption by 1985 (Table 6). To meet this limited goal, more than 200 million tons of additional cereals will be required for feed during a period in which the population of the LDC's is projected to grow by 1.1 billion. Unless this grain can be made available or alternate feed sources can be found, per capita availability of animal protein in the LDC's could well decline in the next decade.

However, before grain can be fed to livestock in many LDC's it will be necessary to increase supplies for human food. Tremendous efforts have been made to do this in recent years and in some countries cereal yields have been raised dramatically. This undoubtedly has had a major

impact on food and feed supplies and on indicating the potential of new technology in the LDC's. Unfortunately the availability of the inputs necessary to apply the new technology varies a great deal and there is a tendency for them to be more accessible to better-off farmers and to those with the best land. As a result, the so-called 'green revolution' has sometimes accentuated the nutritional and economic problems related to income differentials and in doing so has highlighted the complex relationships between the introduction of new technology and the bringing about of socio-economic progress to lower income rural people.

These relationships are even more complex when we move into the livestock sector in which the stock often represent a multi-purpose component of a complex farming system and may serve as sources of capital, hides, skins, hair, wool, manure, meat, milk and draught power. There is often a delicate inter-relationship between these functions, especially in ruminants, and disturbing this delicate balance by giving undue emphasis solely to meat or milk production may easily decrease overall productivity. In the case of pigs and poultry the transfer of technology is less difficult to bring about, and provided that appropriate price relationships and marketing channels exist, modernisation of these industries can occur very rapidly when appropriate feed is available.

In large parts of Asia, animal draught power is essential if crop planting is to be completed within the time limits imposed by climate. Draught animals may only be required to work, perhaps, 30 or 40 days a year, although they may use up 25 to 35 percent of the total annual farm

energy production.

Given this situation, low animal productivity may represent the optimum use of a farmer's total resources. His total farming system is often a sophisticated equilibrium between man, his draught animals and his crop and, for example, the introduction of an extra rice crop a year, which may mean a higher yield and income from rice. It may not necessarily benefit total income if the extra crop can only be planted by burning the stubble, thereby depriving the draught animals of their major energy source.

A further impediment to rapid growth in livestock production is the small subsistence farmer with one or two multiple-purpose animals. Such farmers may not have the feed or capital resources to increase their stock numbers and may prefer the security of a cow producing a litre of milk a day for domestic consumption throughout a period of 20 months to an animal producing 5 litres daily for 10 months, but which is more susceptible to disease and whose milk has to be transported in the hot sun to a maybe distant and unreliable marketing outlet. To such a farmer the maintenance of stable production with limited risks may be a more important motive than maximising income by introducing a new risk element.

Although this is perhaps not the place to discuss population strategies, there can be little hope for meeting animal protein requirements unless and until the rate of growth of world population can be checked. Every year this is increasing by about 75 million with 80 percent of the increase taking place in the LDC's. To meet current food intake levels a century hence implies a ten-fold or greater increase in agricultural

production if population growth rates continue at their current level. Enormous investments will be needed to bring more land into production. In many countries extra land is just not available and in others we know little of the long-term effects on the environment of large scale forest or jungle clearance; large areas of good arable land are steadily being lost through urbanisation to house the expanding population; incredible quantities of water and energy will be required for future domestic, industrial and agricultural use.

Because of the increasing pressure on land for crop production, livestock are being pushed more and more onto marginal land and as a result both production and numbers may well decline, as has already occurred in parts of Turkey, Korea and West Africa. Given this situation, as well as the rising costs of both the labour and the physical inputs needed for intensive grassland production, I suggest that in the future we may expect a change in the pattern of ruminant meat production with more emphasis being placed on rearing from lands unsuited for food production, with stock produced in this way being finished either on by-products and/or on new types of feed which are more effective converters of solar energy than traditional cereals.

Since a large part of the world's ruminant population, rangelands and unutilised by-products are found in the tropics, where in any case there is a greater intensity of solar radiation, this is the area from which greater production must come, even though passing range grassland through cattle can be a wasteful process (1,2). However, until an alternative

system of utilising rangeland and its incident solar energy can be found, extensive cattle grazing would appear to be the most effective use.

Many traditional rangeland systems are already under pressure from a variety of factors such as lowered stock and human mortality, encroachment of crop lands and the availability of consumer goods. Earlier attempts to control range use, especially communal grazing, have persistently failed, but evidence is now accruing, especially in Africa, that the development of a monetary economy is inducing stock owners to voluntarily reduce grazing pressure and to conserve rangeland by selling off stock. This change is usually closely related to the development of a more modern marketing system associated with a stratified pattern of production.

The restructuring of the cattle industry in this way has come about quite rapidly in Kenya where three types of enterprises have evolved: rangeland rearing, growing out on better grassland, and feedlot finishing (3). As a result both the quality and quantity of national meat production has been improved and higher prices have had their impact even on the nomadic producers.

The Kenya system has used corn as the primary source of its feedlot energy, although in the long run its success will probably need to depend on an energy source that is not competitive with human food. However, historically the range of alternatives has never been very large and even today most concentrate rations fed in the tropics are largely based on formulations used by large European and North American compounders.

Only in the last few years does a serious effort appear to have been made to utilise tropical by-products on a large scale and to produce tropical crops of high biological efficiency specifically for use as livestock feeds.

Indeed in terms of utilising solar energy rather than producing specific commodities, the potential of tropical agriculture has never been extensively exploited. In tropical regions the higher light saturation values and higher maximum rates of photosynthesis provide higher efficiencies of energy conversion, and taken in conjunction with the greater annual energy input and the absence of limitations due to low temperature, enable much higher dry matter yields to be attained than are feasible in temperate agriculture. For example, whereas a cereal yield of 5 tons/ha represents a conversion of only about 0.6 percent of the annual input of light energy into grain (4), recorded annual yields of both dry matter production and solar energy conversion from tropical crops such as Pennisetum purpureum, sugarcane and cassava, are often multiples of the temperate data.

Progress reports on the use of some by-products such as coffee pulp and surplus bananas and some tropical crops of high biological efficiency such as sugarcane (molasses) and cassava are being presented here this week. These reports do not cover all the opportunities available for developing new feeds in the tropics. In Senegal a diet containing 40-50 percent groundnut hulls is being used with undecorticated cottonseed, sorghum bran and molasses to obtain daily gains of 1 kg in cattle. In the Caribbean the product of an interesting new process for derinding

sugarcane forms the main component of a ration giving gains of a similar magnitude (5). Although the use of a number of these new diets may not yet be economic it could well become so in the future, within the dynamic framework which surrounds feed:meat price ratios and the future prospects for these two commodities.

Both cassava and cane are used to produce human food and have received relatively limited attention as animal feeds until recently, although Preston (6) has pointed out that the readily available energy per hectare from molasses may be up to four times that of cereals, and de Vries et al (7) have stressed that cassava, too, appears to outproduce cereals and to have a high biological efficiency, perhaps because of the fact that its yield is not constrained by the many problems associated with flowering.

There is currently a trade of 2 million tons a year in dried cassava from the Far East to the EEC where it substitutes for cereals, because the Common Agricultural Policy allows its importation at a low tariff, although in energy terms its value is similar to maize. Recent projections (8) indicate a market potential for cassava in the EEC of between 4.5 and 9 million tons by 1980, in addition to a great deal of interest from Japan and a vast untapped potential existing in the cassava-producing developing countries themselves.

At present, feed compounders rarely use more than 15 percent dried cassava in their rations although there is now ample evidence (9) to show that, providing that the ration is adequately textured and supplemented,

principally with methionine, up to 60 percent dried cassava can be used in poultry and swine diets.

Cassava-based rations, like those of many other tropical crops and grasses, are generally low in protein and require supplementation. Currently much of such supplementation is from oilcakes of which over 30 million tons a year go into animal feeds. Oilcake production is expected to continue to grow as the human demand for vegetable oils increases. However, in the future there may be a need to rely more on non-protein nitrogen such as biuret or urea, whose use in livestock feeds has been growing rapidly in recent years.

A number of efforts are also being made to develop the use of single cell protein for use as both food and feed. Amongst the substrates currently under study are carobs, methanol, spent bisulphite liquor from pulp mills, molasses, gas oil, animal feedlot manure and cassava (9, 10). Some of these projects have already reached the pilot or commercial stage.

In view of the rising price of bag nitrogen there would also seem to be a real need to give more emphasis to the role of the pasture legume, especially in the tropics. Tropical pasture legumes are not widely used outside of Australia, a fact that is probably related to the cheap price of bag nitrogen in recent years and to the relative ease of managing grass pastures compared with grass legume ones. Perhaps in the long term we may hope to see the enrichment of pastures resulting from current research in the field of protoplast fusion, with the production of grasses which have their own nitrogen-fixing Rhizobia.

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In referring to animal protein requirements in the future we may also need to give some thought to the type of animal that will be most productive on the feed available. Some years ago (11) it was shown that Zebu cattle digested crude protein and other nutrients more efficiently and consumed more feed DM on low protein diets than did European cattle, whereas on standard nutritionally adequate diets there was no difference between the two races. More recently Bressani (12) has shown that native (criollo) pigs in Guatemala outperformed Duroc-Jerseys on 6.5 percent but not on 14 percent protein rations. This kind of genotype-environmental interaction assumes considerable importance when we look at the vast numbers of criollo pigs and zebu type cattle owned by peasant farmers and when we explore the potential for increased production through better feeding of these animals.

Many past efforts at livestock improvement in the tropics have failed through trying to introduce the adoption of skilled and capital intensive Western technology. Dr. Bressani's criollo pigs on a 6.5 percent protein high coffee pulp ration certainly don't look as nice as Large Whites on a balanced diet, but they are better than the average local criollo pig, are well adapted to their environment, grow well on a rather cheap food and don't involve a big cash outlay in a society that lacks money.

There are two other sources of animal production which I wish to mention briefly, wildlife and fish. At the risk of being controversial, because it is a highly emotive subject, I am going to express the opinion that neither domestication of species such as the eland, nor game ranching,

will make any significant impact on world animal production in the future. Both concepts are attractive to the biologist and the conservationist but I do not see either proposal making a real impact on future meat supplies because, in the case of domestication, the resource base is so small and the time involved too long and, with respect to game cropping, the problem of marketing is so complex.

In contrast, a real growth centre for animal production - if that is the correct expression - in the future would seem to be aquaculture. Inland waters do not usually compete with crop land, they are largely unexploited, food conversion can be as high as 1 kg fish per kg of dry food and per ha yields in excess of 3 tons have been recorded. In addition, apart from its direct use as human food, one-third of the world's fish catch (mainly marine) is currently processed into fish meal for use as animal feed.

Unless population growth can be drastically curtailed and better use can be made of resources such as atmospheric and waste nitrogen and of incident solar energy, the world of the future may find itself short of both carbohydrate and protein. The greatest potential for long term growth in animal production appears to lie in a better utilisation of tropical lands through the improved use of the ruminant for producing young stock on land unsuitable for crop production, coupled with the fattening of these stock on a combination of feed produced from crops of high biological efficiency (such as sugar and cassava) and tropical crop by-products, with protein supplies being increasingly derived from sources

such as non-protein nitrogen, single cell protein and by-products of inland fisheries.

If all this sounds too reactionary to those of you accustomed primarily to European agriculture, perhaps I may refer you to tomorrow morning's papers in which the authors describe how some of these changes are actually taking place.

REFERENCES

1. Love, R.M. (1970): The rangelands of the Western U.S. Sci. Am. 222: (2) 88-97.

2. MacFadyen, A. (1964): Energy flow in ecosystems and its exploitation by grazing. In Grazing in terrestial and marine environments pp 3-20 Ed. Crisp. Oxford:Blackwell.

3. Creek, M.J., Destro, D., Miles, D.G., Redfern, D.M., Robb, J., Schleifer, E.W. and Squire, H.A. (1973): A case study in the transfer of technology, the UNDP/FAO Feedlot project in Kenya. Proc. 3rd Wld. Conf. on Anim. Prod. Vol. 2 paper 3(a) 29, Melbourne.

4. Cooper, J.P. (1970): Potential production and energy conversion in temperate and tropical grasses, Herb. Abstr. 40: (1) 1-15.

5. Donefer, E., James, L.A., and Laurie, C.K. (1973): Use of sugarcane derived feedstuffs for livestock, Proc. 3rd Wld. Conf. on Anim. Prod. Vol. 3 paper 5 (c) 27, Melbourne.

6. Preston, T.R. (1971): The use of urea in high molasses diets for milk and beef production in the humid tropics, in Report of an Ad Hoc consultation on the value of non-protein nitrogen for ruminants consuming poor herbages pp 101-113, Rome:FAO.

7. de Vries, C.A., Ferwerda, J.D., and Flach, M. (1967): Choice of food crops in relation to actual and potential production in the tropics. Neth.J.Agric.Sci. 15: 241-248.

8. Phillips, T.P. (1974): Cassava: A study of its utilisation and potential markets. (in press) Ottawa, I.D.R.C., P.O.Box 8500.

9. Nestel, B.L. (1973): Current trends in world cassava research (in press). In Proc. 3rd Int. Symp. on Tropical Roots and Tubers. Ibadan: Univ. Press.

10. Protein Advisory Group of the United Nations System (1973): Rep. of the 3rd Mtg. of the PAG Ad Hoc Wking. Gp. on Single Cell Protein, United Nations, New York 10017.

11. Hentges, J.F.Jr., and Howes, J.R. (1963): Digestibility of Feed by Brahmans and Herefords in Crossbreeding Beef Cattle pp 148-152 Eds. T.J. Gunha, M. Koger, and A.C. Warnick, Gainesville: Univ. Fla. Press.

12. Bressani, R. (1974): In Annual Report for 1973 (in press) Guatemala City: Instituto de Nutrición de Centro America y Panama (INCAP).